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TO:	Examiner William C. Jung	
FROM:	Anita J. Lemke	USER ID:8084
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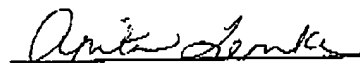
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the Application of:)	I hereby certify that this paper is being filed on January 21, 2003, under 37 C.F.R 1.6 via facsimile to TC3700 Before Final number 703-872-9302.
Franz Steinbacher)	
Josef Steininger)	
Serial No. : 09/954,808)	Anita J. Lemke
Filed: September 18, 2001)	Reg. No. 51,935
For: METHODS AND APPARATUS FOR ULTRASONIC COMPOUND IMAGING)	DATE: January 21, 2003
)	Examiner: William C. Jung
)	Group Art Unit: 3737

AMENDMENT UNDER 37 C.F.R. §1.111

Commissioner for Patents
Washington, D.C. 20231

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Box Non-Fee Amendment

Dear Sirs:

The following is in response to the Office Action mailed October 23, 2002.

REMARKS

Claims 1-23 were originally presented and remain pending in the present application. It is respectfully submitted that the pending claims define allowable subject matter.

Claims 1-4, 6-8, 12, 13, 17-19, and 23 have been rejected under 35 U.S.C. § 102(b) as being unpatentable by Seyed-Bolorforosh et al. (USP 5,891,038). Claims 1, 5, 14, and 15 have been rejected under 35 U.S.C. § 102(a) as being unpatentable by Bolorforosh et al. (USP 6,277,073).

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Claim 16 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over Seyed-Bolorforosh et al. (USP 5,891,038) in view of Rust et al. (USP 6,050,942). Claims 9-11 and 20-22 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Bolorforosh as applied to claims 1 and 17, and further in view of Rust et al. (USP 6,050,942). (Applicants believe that the last rejection is referencing Seyed-Bolorforosh et al. (USP 5,891,038) rather than Bolorforosh et al. (USP 6,277,073) in view of the statement in the Office Action "as applied to claims 1 and 17".) Applicants respectfully traverse the outstanding rejections for reasons set forth hereafter.

Independent claims 1 and 13 require the steps of "receiving first and second echoes from said [region of interest] ROI" and "combining said first and second echoes along said entire scan line to form a composite scan line." (emphasis added) These claims further specify "said first echo representing reflections along an entire scan line of said first ultrasound beam, said second echo representing reflections of said entire scan line of said second ultrasound beam." (emphasis added) Independent claim 17 requires the step of "receiving a plurality of first echoes and a plurality of second echoes from said [region of interest] ROI, said plurality of first echoes being received simultaneously and representing reflections along an entire scan line of said first ultrasound beam, said plurality of second echoes being received simultaneously and representing reflections along said entire scan line of said second ultrasound beam." (emphasis added) Claim 17 also requires the step of "combining said first plurality of echoes and second plurality of echoes along said entire scan line to form a composite scan line." (emphasis added)

The Office Action states that in Seyed-Bolorforosh, each scan line is represented by a composite of multiple received signals respective of each transmission. However, Seyed-Bolorforosh uses only a portion of the reflected waveform:

> Referring to FIG. 9, the invention further comprises conventional means, i.e., transducer 10 and beamformer 38, for forming a first basebanded complex signal pair (I1 and Q1 signals) of a first receive ultrasound waveform derived from the portion of the first transmit ultrasound waveform reflected back to selected receiving transducer elements by scatterers in a focal zone encompassing the first focal point and subsequently forming a second basebanded complex signal pair (I2 and Q2 signals) of a second receive ultrasound waveform derived from the portion of the second transmit ultrasound waveform reflected back to selected receiving

transducer elements by scatterers in a focal zone encompassing the second focal point. (col. 7, lines 45-57, emphasis added)

The foregoing statement does not disclose receiving echo data from along the entire scan line, nor is it disclosed or suggested anywhere else in Seyed-Bolorforosh. Instead, Seyed-Bolorforosh selects portions of the scan line from first and second received waveforms based upon focal zones comprising first and second focal points, respectively.

Furthermore, no suggestion is made by Seyed-Bolorforosh to combine the entire scan lines of separate echo signals. Rather, Seyed-Bolorforosh teaches acquiring and then splicing data from different focal zones of multiple transmit beams:

> The reflected ultrasound is sampled from the focal zones of two or more transmit beams each focused at different depths along the same scan line. In most recent ultrasound imaging systems the received signal is dynamically focused as signals from different depths are received. For each steering angle, the sampled data from contiguous focal zones is acquired and then spliced to make one vector or A-line. (col. 1, lines 53-60)

Hence, claims 1, 13, and 17 are patentable over Seyed-Bolorforosh. Claims 2-4, 6-8, and 12 depend from claim 1, and claims 18-19, and 23 depend from claim 17. These dependent claims are patentable over Seyed-Bolorforosh for the reasons given above in connection with claims 1 and 17.

Claims 1, 5, 14, and 15 have been rejected under 35 U.S.C. § 102(a) as being unpatentable by Bolorforosh. Claim 1 requires the steps as described previously. Independent claim 14 requires the step of "receiving first and second echoes from said [region of interest] ROI, said first echo representing reflections along an entire scan line of said first ultrasound beam, said second echo representing reflections of said entire scan line of said second ultrasound beam." (emphases added) Claim 14 also requires the step of "combining said first and second echoes along said entire scan line to form a composite scan line in an ultrasound image." (emphasis added)

Bolorforosh is directed to "imaging methods that increase the number of transmit focal zones while maintaining a high frame rate." (col. 1, lines 8-10) Accordingly, receiving the reflections of the transmitted beams is addressed only briefly. Bolorforosh combines echoes to form a resultant scan line, stating "that only a segment of an image line is formed with each

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transmit focal zone, and many transmit focal zones are required to form a high resolution image." (col. 1, lines 24-26, emphasis added) Furthermore, when transmitting a beam including the first point focus at R1*a* and the second point focus at R1*b*, as discussed in col. 3, lines 46-57, "the receiver 18 in this example is preferably a multiple beam receiver that generates a separate receive beam for each of the separate point foci of the first transmit event." (col. 3, lines 58-60, emphasis added) Therefore, Bolorforosh generates a receive beam for the first point focus at R1*a* and a different receive beam for the second point focus at R1*b*. Also, when interleaving transmit focal zones as illustrated in Fig. 9, Boloforosh states that "it is preferred that the receive information be stitched together from staggered segments of data." (col. 5, lines 11-13) Thus, it is respectfully submitted that Bolorforosh neither anticipates nor renders obvious independent claims 1 and 14.

Claim 16 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over Seyed-Bolorforosh in view of Rust. Independent claim 16 requires the step of "receiving first and second echoes from said [region of interest] ROI, said first echo representing reflections along an entire scan line of said first ultrasound beam, said second echo representing reflections of said entire scan line of said second ultrasound beam." Claim 16 also requires the step of "multiplying said first and second echoes by a weighting factor equal to 1/N to form first and second weighted echoes, wherein N is equal to a number of ultrasound beams transmitted along a common scan line in said transmitting step."

Seyed-Bolorforosh does not anticipate nor render obvious claim 16 for reasons stated above in relation to claim 1. Moreover, Rust fails to address the deficiencies of Seyed-Bolorforosh. Specifically, Rust does not teach or suggest receiving data representing an entire scan line of an ultrasound beam, but instead states "each line buffer stores the first half aperture beamformed echo signals for synthetic aperture formation. The stored first half aperture signals are combined with the second half aperture signals as the latter are produced to form echo signals from the full synthetic aperture." (col. 3, lines 52, 57)

The Office Action states that the weighting factor is determined by the number of scans used to obtain the composite signal as shown in Fig. 4 of Rust. However, Fig. 4 "illustrates a pattern of interpolated scanlines produced by a preferred embodiment of the scanline signal

processor of the present invention." (col. 1, lines 62-64) Rust does not directly reference Fig. 4

again, although Applicants believe that Fig. 4 illustrates additional scan line data which has been

interpolated by interpolator 36,136 (Fig. 2) between two received scan lines. Rust states that "the

two interpolated scanlines are of the form $0.75L_n + 0.25L_{n+1}$ and $0.25L_n + 0.75L_{n+1}$, where L_n and L_{n+1}

are consecutively received scanlines." (col. 3, line 65 – col. 4, line 1) Therefore, Rust illustrates

interpolated scan lines in Fig. 4 and does not combine multiple scan lines with a weighting factor

determined by the number of ultrasound beams transmitted along a common scan line.

Furthermore, Rust applies coefficients according to gain, attenuation, scan head

characteristics and/or the type of signal being processed. Specifically, Rust states:

> In a preferred embodiment the coefficients of the coefficient circuits apply a gain or
> attenuation characteristic which is a combination of the two characteristics 200,202
> or 200,204. Preferable, the coefficient memories 32,132 store multiple combined
> gain curves which are changed with memory addressing to match scanhead
> characteristics or the type of signals being processed (2D or Doppler). (col. 3, lines
> 40-46)

Therefore, it is respectfully submitted that claim 16 is patentable over Seyed-Bolorforosh in

combination with Rust.

Claims 9-11 and 20-22 have been rejected under 35 U.S.C. § 103(a) as being unpatentable

over Seyed-Bolorforosh as applied to claims 1 and 17, and in further view of Rust. Claims 9-11

depend from claim 1 and claims 20-22 depend from independent claim 17. Claims 1 and 17, and

thus dependent claims 9-11 and 20-22, are patentable over Seyed-Bolorforosh for the reasons given

above.

Moreover, claims 10 and 21 recite further patentable features, which distinguish these

claims from Seyed-Bolorforosh and Rust. Claims 10 and 21 recite "wherein the at least one

weighting factor equals 1/N, wherein N is equal to a number of ultrasound beams transmitted along

a common scan line in said transmitting step", which is neither disclosed nor suggested by Seyed-

Bolorforosh or Rush. Seyed-Bolorforosh states that "in the preferred method the coefficients

should vary dynamically with time since the goal is to generate a synthetic signal with a

symmetrical spectrum at all depths. The coefficients can be specified in terms of the tissue

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absorption and frequency-dependent scattering characteristics." (col. 8, lines 27-32) Rust fails to address the deficiencies of Seyed-Bolorforosh. Namely, Rust does not teach or suggest combining multiple scan lines with a weighting factor determined by the number of ultrasound beams transmitted along a common scan line, as discussed previously in connection with claim 16. Hence, claims 10 and 21 are patentable over Seyed-Bolorforosh and Rust.

It is respectfully submitted that the pending claims define allowable subject matter. Should anything remain in order to place the present application in condition for allowance, the Examiner is kindly invited to contact the undersigned at the telephone number listed below.

Please charge any additional fees or credit overpayment to the Deposit Account of McAndrews, Held & Malloy, Ltd., Account No. 13-0017.

Respectfully submitted,

McANDREWS, HELD & MALLOY, LTD.

Date: January 21, 2003   By: _____
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